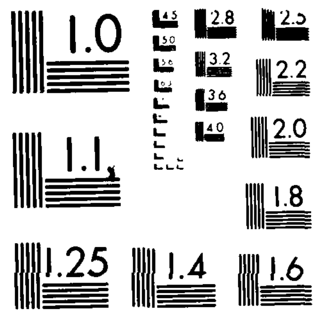
AD-A141 894 TACTICAL ELECTRONIC WARFARE ENVIRONMENT SIMULATOR 1/1
REAL-TIME SUBSYSTEM VOLUME 2 DESIGN DESCRIPTION(U)
AMHERST SYSTEMS INC BUFFALO NY E G EBERL JAN 78
UNCLASSIFIED N00173-77-C-0105 F/G 17/4 NL

END
DATE
FILMED
7-84
DTIC



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963 A

AMHERST SYSTEMS INC.

TACTICAL ELECTRONIC WARFARE
ENVIRONMENT SIMULATOR

REAL-TIME CONTROL SUBSYSTEM

FINAL REPORT

VOLUME 2

DESIGN DESCRIPTION

JANUARY 1978

Written By:

Dr. Edward G. Eberl
Amherst Systems, Inc.

Written For:

Naval Research Laboratory
Washington, D. C. 20375

Contract Number N00173-77-C-0105

132 CAYUGA ROAD • BUFFALO, NEW YORK 14225 • 716-631-0610

SECTION 1

INTRODUCTION

The software for the TEWES resides in the Control Subsystem which includes a CPU with 48K word memory interfaced to two moving head disk drives, an operator terminal, a printer, and interfaces to the TEWES Digital Subsystem (specified in Appendix D) and the Navigation Computer of the system under test (specified in Appendix E). The disks will hold the computer programs and data. The data files include scenario files (specified in Appendix A) which describe the environment to be simulated, Maximum Power, Antenna Gain and Threshold files (specified in Appendix C) and data extraction files (specified in Appendix B) which are used to store scenario events, operator actions, and stimulator status information. The operator's terminal consists of a 24 line by 80 character CRT and a standard keyboard. The terminal is used by the operator to enter commands to control the simulation and modify the scenario and to display status messages.

The TEWES real time software consists of two separate tasks designed to operate under Digital Equipment Corporation's (DEC) RSX-11M executive. The first, which is referred to as program OTASK, was written using both the Fortran IV and Macro-11 languages. Program OTASK provides all direct communications with the operator. The second task, which is referred to as program REALTM is written entirely in the Macro-11 language. It controls all real time processing, as well as providing support for scenario file input and data extraction file output. A third program unit, common task OPERC, provides a common block of data through which the two programs can communicate.

Program REALTM maintains a Platform File (specified in Appendix F) and an Emitter File (specified in Appendix G) in main memory. The Platform File contains position, velocity, range attenuation, bearing, and heading fields for up to 255 target platforms or sites and the platform for the EW system under test. The Emitter File contains platform, power, and scan data for each emitter. Once per second, the program will update the position of each platform and recalculate its range attenuation and bearing. If either of these values has changed by an amount equal to or greater than the simulator minimum change capability, an updated bearing and attenuation will be output to the Digital Subsystem for each emitter associated with the platform.

The Scenario file on disk contains a series of events in time order. Events include the appearance of new platforms and emitters and changes in platform motion and emitter status. Each event has a time associated with it which is used by the program to process the event at the proper time.

Operator commands are included to initialize and start the simulation, stop the simulation, speed up or slow down the scenario, set the scenario to a specific time, turn radiation on or off, control the interface to the EW system under test, and end the simulation run. The operator can also enter events to add to or change the simulation as it is running.

While the simulation is running the program records time tagged data on the disk in a data extraction file. The data recorded includes each event and operator command executed, pulse dropout data and any error indicators from the digital subsystem. The Data Extraction file can be used by offline analysis programs to evaluate the performance of the EW system under test.

The program will also transmit the position of the platform for the EW system under test to the Navigation Computer every .5 second.

A-1

SECTION 2

COMMON AREA OPERC

Common task OPERC is a global common block, which is a feature of the RSX-11M operating system. Any number of programs can be linked to this common area simultaneously with both read and write access privileges. Both program OTASK and program REALTM are linked to this region. The region is treated as if it were a named Fortran common block, which contains data which are needed by both programs, including variables needed to transmit commands from OTASK to REALTM, and status information which is returned to OTASK upon completion of command processing. The following parameters are included in this region.

a. Command Flag, which is used by OTASK to signify that an operator command is ready to be processed.

b. Command Code, which identifies the command type which is to be executed.

c. Tick Count, which is a measure of the elapsed time since the start of the program, measured in sixtieths of a second. This is a double precision integer field.

d. Parameter Array, which is a 26 word integer array used to transmit any parameters associated with the current command.

e. Error Flag, which is used by REALTM to notify OTASK of any errors in processing the current command.

f. Information Array, which is a 20 word integer array used to return emitter and platform data to OTASK for display purposes.

g. Threshold Array, which is a 160 word integer array containing default thresholds as read from the threshold file.

h. Attenuation Array, which is a 160 word integer array containing attenuation factors composed of the maximum available power, attenuated by receiving antenna gain and frequency factors.

i. Special Channel Array, which contains default thresholds and attenuation factors associated with the ten special sources.

j. Buffer Array, which is used for transfer of dropout counts from the Digital Subsystem via a direct memory access device.

SECTION 3

PROGRAM OTASK

Program OTASK is divided into three main sections. The first provides initialization functions. The second major section provides operator command and status display functions. The last section provides the capability for the operator to enter events.

3.1 INITIALIZATION

The initialization section processes all necessary information needed to start a simulation run. Its first task is to initiate program REALTM, to process the initialization data. If program REALTM cannot be successfully initiated, OTASK takes an immediate exit, as this is a fatal error. When program REALTM has been successfully initiated, the Maximum Power, Antenna Pattern, and Threshold files are read and processed. The name of the Threshold file is input from the operator, and values from the file are read, rounded to integer format, and stored in common area OPERC. The Maximum Power file name is input from the operator, and values are read and stored in a temporary array. The Antenna Pattern file name is input from the operator. Values are read, combined with the data stored in the temporary array and frequency related terms. The result is rounded to integer format and stored in common area OPERC.

The Data Extraction and Scenario file names are input from the operator and passed to program REALTM to be opened. If an error is returned, the process is retried until both files have been successfully opened. The EW system platform number is input and passed to program REALTM for processing. The frequencies for channel one switch positions three and five, and channel two switch positions one and two are input from the operator. The frequencies for the other six special sources are stored permanently within the program. These ten frequencies are
RF channel Select
converted to equivalent VCO numbers and frequency offsets, which are passed to program REALTM to be recorded in the Data Extraction file. The default threshold and attenuation factors for the ten special sources are determined and stored in common area OPERC. This completes the initialization procedure.

3.2 OPERATOR COMMANDS

The Operator Command section processes all operator commands, and all status information returned by REALTM. All command data and status information are stored in common area OPERC, allowing both program OTASK and program REALTM free access to all values. When an operator command has been completely specified, the Command Flag in common area OPERC is set to notify program REALTM that a command is ready to be processed.

Program OTASK then issues a WAIT FOR EVENT FLAG request to the RSX-11M Executive. The EVENT FLAG is an internal feature of the Executive, not to be confused with a scenario event. When the WAIT request is issued, program OTASK is placed in a dormant state until the specified EVENT FLAG is set. The Executive will automatically restart program OTASK when program REALTM sets the appropriate event flag. Program OTASK does not place any load on the central processor while waiting for a command to be processed.

Each command has an internal Command Code associated with it which is stored in common area OPERC. Command Codes are assigned as follows.

64	Start Scenario
65	Stop Scenario
66	Set Scenario Speed
67	Radiation Off
68	Radiation On
69	Advance Scenario
70	Backup Scenario
71	Set Counter Variables
72	Set RF Detector-Counter Band
73	Specify Platform with EW System
74	End Simulation Run
75	Enable-Disable Dropout Recording
76	Record Special Channel Frequencies
80	Initiate Automatic Repeat Loop
81	Display Emitter Parameters
82	Initialize ?

Command Codes 73, 76 and 82 are used only during the initialization process, and are not normally available to the operator.

When a Command has been entered, the corresponding Command Code is stored in common area OPERC. Any parameters associated with the command are requested from the operator. The Command Flag is then set to notify program REALTM, and program OTASK is placed in the WAIT STATE until the command is processed.

When program OTASK is restarted the Error Flag in common area OPERC is tested for any error conditions. If any error is present, an appropriate message is output to the operator. If the last command was a Display Emitter Parameter command and no error was encountered, the data in the Information Array in common area OPERC are displayed on the operator's console. Program OTASK then waits for the next Command Code to be entered.

3.3 OPERATOR ENTERED EVENTS

Program OTASK also provides the capability for the operator to enter events. Any event which can be included in a scenario file can also be input by the operator. The event numbers, which are also used as Command Codes, are assigned as follows.

1	Enter New Platform
2	Delete Platform
3	Velocity Change
4	Platform Reposition
5	Enter New Emitter
6	Delete Emitter
7	Emitter Off
8	Emitter On
9	Change Emitter Parameter

When an Enter Scenario Event command is issued, the operator is prompted to enter first the Event Code, and then all data necessary to specify the event. When all required data have been entered, the Command Flag is set in common area OPERC and program OTASK is suspended until the event has been processed by program REALTM.

When program OTASK is restarted, the Error Flag in common area OPERC is checked, and a warning message is issued if an error code is found. Program OTASK then waits for the next Command Code to be entered.

SECTION 4
PROGRAM REALTM

Program REALTM has three main memory files associated with it, in addition to the Main Control Loop and processing segments. The memory files include the Emitter File, the Platform File, and a Control File. The processing sections include Initialization, Simulated Time and Navigation Computer Output, Dropped Emitter Processing, Status Data Processing, Command Processing, Platform Update, Event Processing, and Disk File Support.

4.1 EMITTER FILE

The Emitter File contains a four word information record for each of up to 1023 active emitters. For emitters with stagger or group PRI modulation, consecutive records are used, with one record assigned for each distinct PRI value in the PRI modulation pattern. Records are indexed by emitter number. Each emitter record contains the following fields.

a. Next Emitter Number. This one word field is used to chain all emitters for a given platform into a linked list. The list is terminated with a value of 100000(8).

b. Radiated Power. One byte to hold radiated power in dBm as specified in the Enter New Emitter Event.

c. Minimum Range Attenuation. The attenuation value to be output to the Digital Subsystem whenever the distance between the emitter's platform and the EW system platform is less than 128 meters.

d. Scan Multiplier. Shift count for adjusting bearing information before output to the Digital Subsystem to correct for the antenna beamwidth.

e. Platform Number. One byte to index the platform number with which the emitter is associated.

f. Flags. One word with the following one bit flags.

i. Record Dropout Data (Logical AND of next two bits.)

ii. Dropout Data Recording Enabled.

iii. Emitter is On.

iv. Operator's Emitter.

v. Multiple PRI link indicates next emitter is an additional PRI for the current emitter.

vi. Parameter Change Bits. One flag for each of the five groups which can be specified in an operator entered Change Emitter Parameter event. Inhibits the scenario from changing parameters set by the operator.

4.2 PLATFORM FILE

The Platform File contains a 14 word record for each of up to 256 platforms or sites including the EW system platform. Records are indexed by platform number. The following fields are included.

a. X Position. Two word field containing the East-West platform position. Least significant bit represents .125 meters.

b. Y Position. Two word field containing the North-South platform position. Least significant bit represents .125 meters.

c. Z Position. Two word field containing the altitude of the platform. Least significant bit represents .015625 meters.

d. X Velocity. One word field containing the East-West velocity of the platform. Least significant bit represents .125 meters/second.

e. Y Velocity. One word field containing the North-South velocity of the platform. Least significant bit represents .125 meters/.

f. Z Velocity. One word field containing the climb rate of the platform. Least significant bit represents .015625 meters/second.

g. Heading. One word field containing the platform heading, measured clockwise from true North. Least significant bit represents .3515625 degrees.

h. Bearing to EW System Under Test. One word field containing the relative bearing from the platform to the platform containing the EW system under test. Least significant bit represents .3515625 degree.

i. Range Attenuation. One word field to contain the range attenuation of the platform in dB.

j. Emitter Pointer. One word field to contain the number of the first emitter linked to the platform. A value of 100000(8) is stored when no emitters are linked.

k. Flags. One word containing the following flags.
   i. Operator's platform flag.
   ii. Active flag.
   iii. EW system platform flag.

4.3 CONTROL FILE

The Control File is an internal memory file used by program REALTM to store status and timing data, as well as operator command parameters. The following fields are included.

a. Simulated Time. A one word field containing the simulated time in seconds since the start of the scenario.

b. Time Increment. A one word field containing the amount by which Simulated Time is incremented. This value is one when the scenario is running at or slower than real time, and 8, 4, or 2 when the scenario is running at 8, 4, or 2 times normal speed.

c. Next Half Second. A one word field containing the number of ticks (sixtieths of a second) left in the current half second interval. Decremented every tick and reset to thirty when zero is reached.

d. Next Second. A one word field containing the number of half-second intervals until the next even second. Decremented every half-second and reset to two when zero is reached.

e. Simulated Second Interval. A one word field containing the number of seconds per Simulated Second. This value is one when the scenario is running at or faster than normal, and 8, 4, or 2 when the scenario is running at 1/8, 1/4 or 1/2 normal speed.

f. Next Simulated Second. A one word field containing the number of seconds to the next Simulated Second. Decremented every second and reset according to the Simulated Second Interval when zero is reached.

g. Scenario Speed. A two byte field, with one byte containing the shift code for platform velocities which is 0 unless the scenario is running at 8, 4, or 2 times normal speed, at which times it is 3, 2, or 1. The second byte is the shift code for the Simulated Second Interval, which is 0 unless the scenario is running 1/8, 1/4 or 1/2 normal speed, when it is 3, 2, or 1.

h. New Scenario Speed. A two byte field, with one byte containing a flag signifying a new speed is present, and the other byte containing the new speed code as a power of two.

Detector

i. RF Band. A one word field containing the RF Band currently being monitored by the RF Detector-Counter.

Detector

j. RF Mode. A one word field containing the RF Detector-Counter Mode, which is the same as the RF Band unless the cycle mode is selected, when it has a value of -1.

Det[illegible]

k. Read RF Flag. A one word field which is set to 0 every second and set to one each time the RF Detector-Counter is read.

l. Counter Variable Mode. A one word field containing the Counter Variable Mode which is defined as follows.

0	Count pulses output
1	Count pulses inhibited by threshold
2	Count pulses dropped due to lock of RF capacity
3	Count jittered pulses
4	Cycle all four modes.

m. Current Counter Mode. One word field containing the mode the counters are currently in, as defined above.

n. Counter Periodicity. A one word field containing the periodicity in seconds with which the counters are to be read and cleared, either 1, 2, or 4.

o. Counter Flag. A one word field which is set to the Counter Periodicity when the counters are read, and decremented every second.

p. Automatic Stop Time. A one word field containing the Simulated Time in seconds at which the scenario is scheduled to be stopped, or -1 if it is to run indefinitely.

q. Repeat Loop Start Time. A one word field containing the start time in simulated seconds of a repeat loop currently in effect. Undefined if no repeat loop is in effect.

r. Repeat Loop Stop Time. A one word field containing the stop time in simulated seconds of a repeat loop currently in effect, or -1 if no repeat loop is in effect.

s. RF Status. A two byte field containing a flag showing the current status of the RF radiation and a flag showing the last operator status set.

t. Scenario Status. A two byte field containing a flag showing whether the scenario is currently running and a flag showing whether the scenario has ever been started.

u. Next Scenario Event. A three word field containing the event number, time, and memory location of the next event in the scenario file.

v. Update Flag. A one word field which is set to zero each time Simulated Time is incremented, and set to -1 each time an Update is performed.

w. EW Platform Index. A one word field containing the index address in the Platform File of the EW system platform.

4.4 INITIALIZATION

The Initialization section of program REALTM receives and processes all of the information which is input by the initialization section of program OTASK. The first data entered are the Scenario and Data Extraction File names. The scenario file is first opened, and if this is successful, the data extraction file is created, allocating 300 contiguous disk blocks. If the scenario file cannot be found a warning is issued and no attempt is made to create the Data Extraction file. Both file names are reentered and the process is repeated. If the Data Extraction file cannot be created, a warning is issued, the Scenario File is closed, and the process repeated.

After both files have been successfully opened, the EW system platform is entered and recorded in the Data Extraction File. All motion related entries in the Platform File for the EW system platform are set to zero, and the EW system parameters are initialized in the Digital Subsystem. All parameters for emitter 0 are zeroed both in the Emitter File and the Digital Subsystem. The EW system platform is linked to emitter 0. All other platforms and emitters are deleted from the Platform and Emitter Files and all emitters are turned off in the Digital Subsystem. The Control File is initialized showing the scenario running at normal speed and the RF Detector-Counter and Dropout Counter are set in the default cycle mode. The RF Status is initialized showing the RF radiation currently off and the last operator status set as on.

The 10 special channel frequencies are recorded in the Data Extraction File. The initialization is complete (when all scenario events with a time of zero have been executed.) Program REALTM is now ready to receive commands from the operator.

4.5 CONTROL LOOP

The Control Loop manages the execution of all of the processing subsections. High priority tasks are given preference by placing them near the beginning of the loop. The following cycle is continually executed searching for the next task to be processed.

a. If Simulated Time has reached the Repeat Loop Stop Time, Backup and Start Scenario Commands are executed, using the Repeat Loop Start Time stored in the Control File; the Automatic Stop Time is set to the Repeat Loop Stop Time.

b. If the Dropped Emitter Flag is set by the Digital Subsystem, the Dropped Emitter Processing routine is executed.

c. Control is transferred to the Status Data Processing section, which processes any dropout data or RF Detector-Counter data.

d. If the Command Flag is set in common area OPERC, the Command Processing section is executed.

e. If the Update Flag is set, platform positions are updated. If an Update is performed, control is returned to point a. If no Update is performed, execution continues at point f.

f. If the time of the next scenario event stored in the Control File is less than or equal to Simulated Time, the event is executed. The next event is requested from the scenario file and stored in the Control File. If no event is returned, a time of 0 is stored so that another attempt to get an event will be made on the next pass. An event number of 0 is also stored so that the Control Loop will not try to execute the event now pointed to by the Control File.

4.6 SIMULATED TIME AND NAVIGATION COMPUTER OUTPUT

Program timing is achieved through the use of an Asynchronous System Trap, (AST), which is a feature of the RSX-11M Executive. An AST is scheduled to occur 60 times a second, and each time an AST occurs the program is interrupted and control is passed to a timing control section. This routine then performs all timekeeping functions.

For each AST, the tick count in common area OPERC is incremented by one. The Next Half Second count is decremented. If the result is not zero, processing is complete. Otherwise, the count is reinitialized and the position of the EW system platform .5 seconds from now is predicted and output to the Navigation Computer. The Next Second count is decremented, and processing is complete if the result is not zero. If the result is zero, the count is reinitialized, and the Read RF Flag is set and the Counter Flag is decremented. If the scenario is running, the Next Simulated Second count is decremented, and Simulated Time is updated if necessary. If the next Simulated Second will occur in .5 seconds, the Update Flag is set so that the Update begins .5 seconds before the actual time is reached.

At each even Simulated Second, several checks are made. If the updated Simulated Time is beyond the Automatic Stop Time, the Scenario Status is updated, stopping the scenario. A Stop Scenario Command is then recorded in the Data Extraction File. If the New Scenario Speed Flag is set, the new speed code is set, related fields in the Control File are updated, and the Set Scenario Speed Command is recorded in the Data Extraction File.

4.7 DROPPED EMITTER PROCESSING

The Digital Subsystem sets a flag in the interface to the Control Subsystem when it discovers that .5 seconds have passed without a pulse being generated for an active emitter. When this flag is set, the program reads the emitter from the Digital Subsystem, displays a warning message on the operator's console, and records the dropped emitter number in the data extraction file. The emitter is then turned on or off as determined by the status set in the Emitter File.

4.8 STATUS DATA PROCESSING

The Status Data Processing section records all status data in the Data Extraction File as specified by the operator. Whenever the Read RF Flag is set, the RF Detector-Counter is read, and the current band number and count are recorded. The flag is then reset, and a new RF band number is loaded if the automatic cycle mode has been specified.

When Dropout Data have been transferred, the Digital Subsystem sets a flag in the Control Subsystem. When data are available, values are recorded in the Data Extraction File for emitters with the Record Dropout Data flag set. After any available data have been recorded, new data are requested if the Counter Flag is set. When data are requested, the Counter Flag is reinitialized to the Counter Periodicity, and a new count mode is output to the Digital Subsystem if the cycle mode has been selected. The time of the request is stored to be recorded with the dropout counts when the data transfer is complete.

4.9 COMMAND PROCESSING

The Command Processing section is executed whenever the Command Flag is set in common area OPERC. The Command Code is interpreted, and the appropriate action is taken. Individual commands are implemented as follows.

4.9.1 Start Scenario

When a Start Scenario Command is received, the Scenario Status is first checked to see if the scenario has previously been started. If so, the Scenario Status is updated to show the scenario running. The timing routine will then automatically begin updating Simulated Time, and real time processing will take place. If the scenario has never been started, the AST request must be initiated. The initial EW system platform position is output to the Observer, and a .5 second delay is induced to allow for the Observer to initialize its system. The radiation is turned on unless a Radiation Off command has been processed. If a stop time has been included, the value is stored as the Automatic Stop Time in the Control File. If no stop time is specified, this value is set to the highest possible number so the scenario will run indefinitely.

4.9.2 Stop Scenario

The Stop Scenario command causes the current Simulated Time to be placed in the Automatic Stop Time field in the Control File. The Scenario will be stopped at the next Simulated Second, and Simulated Time will no longer be incremented. The Repeat Loop Start and Stop Times are reinitialized. The simulator will continue to generate RF signals unless a Radiation Off command is received.

The current position of the EW system platform is output every .5 second until the scenario is restarted.

4.9.3 Set Scenario Speed

The Set Scenario Speed Command is always implemented at an even Simulated Second. If the scenario is currently stopped, the new speed code is set, related fields are updated in the Control File, and the command is recorded in the Data Extraction File. If the scenario is running, the New Speed Flag is set and the speed code is stored in the Control File, to be implemented by the timing routine at the next Simulated Second.

4.9.4 Radiation Off

The Radiation Off command causes the simulator to cease radiating RF signals. The RF Status is updated in the Control File, and the event is recorded in the Data Extraction File. All other aspects of the simulation are unaffected.

4.9.5 Radiation On

The Radiation On command reverses the effect of the Radiation Off command. If the scenario has never been started the radiation is not actually turned on until the first Start Scenario command. Otherwise, the radiation is turned on immediately. The command is recorded in the Data Extraction File as it is executed.

4.9.6 Advance Scenario

The Advance Scenario command advances Simulated Time to the specified time. If the target time is greater than the current Simulated Time, an error code is

returned in the Error Flag in common area OPERC and no action is taken. If the target time is valid, the scenario is advanced. If the scenario is running, the current Simulated Time is loaded as the Automatic Stop Time, and the program waits until the scenario is stopped.

The RF radiation is turned off, and all events at the current time are processed, all platform positions are updated to either the target time, or the time of the next scenario event. All scenario events scheduled for the current time are processed, and the platform positions are again updated. This cycle continues until the target time is reached, and the final values for emitter bearings and attenuations are output to the Digital Subsystem. The RF radiation is turned on if it was on before the command was processed. All commands are recorded in the Data Extraction File.

4.9.7 Backup Scenario

The Backup Scenario command is similar to the Advance Scenario command except that the target time is less than the current Simulated Time. If this is not true, an error is returned in the Error Flag in common area OPERC, and no action is taken. The current Simulated Time is loaded as the Automatic Stop Time to stop the scenario if it is running. When the scenario has been stopped, the RF radiation is turned off. All platforms and emitters are deleted from the program files, and all emitters are turned off in the Digital Subsystem. Simulated time is reset to zero, and the Scenario File is processed from the beginning. The simulator is then run as fast as possible up to the target time, as with the Advance Scenario command, and the RF radiation is returned to its initial state. All commands are recorded in the Data Extraction File.

4.9.10 Set Counter Variables

The new periodicity and counter mode are stored in the Control File. These new values will be used the next time the counters are read and cleared. The command is recorded in the Data Extraction File.

4.9.11 Set RF Detector-Counter Band

The new RF Detector-Counter Band is stored in the Control File. This new value

is used the next time the counter is read and cleared. The command is recorded in the Data Extraction File.

4.9.12 Enable-Disable ~~Dropout~~ Pulse Count Recording

The polarity flag is tested to determine whether to enable or disable ~~dropout~~ Pulse count recording. When disabling ~~dropout~~ recording, both the Record ~~Dropout~~ Data and ~~Dropout~~ Data Recording Enabled Flags are cleared in the Emitter File for the specified emitters. When enabling ~~dropout~~ recording, the ~~Dropout~~ Data Recording Enabled Flag is set for all of the specified emitters, and the Record ~~Dropout~~ Data Flag is set for those emitters which are currently in the on state.

4.9.13 Initiate Automatic Repeat Loop

The Start and Stop Times specified with the command are stored in the Control File. The scenario is advanced or backed up as needed to the Start Time. The scenario is then started and will automatically be executed between the Start and Stop Times until a Stop, Advance, or Backup Scenario Command is given. The Main Control Loop and timing routine implement the endless loop based on the Start and Stop Times stored in the Control File.

4.9.14 Perform a Scenario Event

An operator entered scenario event is processed in the same way as a regular scenario event. The event number stored in the Command Code in common area OPERC is negated to mark this as an operator's event for the event processing routines. Control is then passed to the appropriate event processing routine to execute the event.

4.9.15 End Simulation Run

The End Simulation Run command causes the scenario to be stopped, RF radiation to be turned off, and the Data Extraction File and Scenerio File to be closed. The program is then terminated, and control returned to the RSX-11M Executive.

4.10 PLATFORM UPDATE

The platform Update is executed each time the Update Flag is set by the timing routine. Execution is once per second when the scenario is running at or faster than normal speed. Execution is every 2 seconds for 1/2 speed, 4 seconds for 1/4 speed, and 8 seconds for 1/8 speed. If the scenario is running at 2, 4 or 8 times normal speed, velocities are shifted left 1, 2 or 3 bits respectively before being used in any calculations.

Positions are updated by adding velocity components to their associated position coordinates. This is first done for the EW system platform. The coordinates are truncated to 16 bits of accuracy, with the least significant bit representing 256 meters, and stored for later use in range calculations.

For each of the other active platforms, the position is updated in the same way. The new coordinates are then scaled to match the stored coordinates for the EW system platform. These values are used to calculate the Slant Range Squared with the following formula.

$$SR^2 = (X_p-X_o)^2 + (Y_p-Y_o)^2 + (Z_p-Z_o)^2$$

The p subscripts represent the current platform and the o subscripts represent the EW system platform. SR^2 is then used in a binary table search to determine the Platform Range Attenuation.

The bearing from the platform with the EW system under test is calculated using the following formula, where the Arctan function is implemented by a binary table search.

$$\text{Bearing} = \text{Arctan}\ \frac{(X_p-X_o)}{(Y_p-Y_o)}$$

The new Range Attenuation and Bearing are compared to the values stored in the Platform File. If neither has changed, processing for the platform is complete. If either has changed, the new values are stored in the Platform File and output to the Digital Subsystem for each emitter linked to the platform. The Bearing

output for each emitter is the Bearing calculated for the platform. The Attenuation output for each emitter is the sum of the Platform Range Attenuation and the Minimum Range Attenuation field stored in the Emitter File.

4.11 EVENT PROCESSING

Events are processed either under supervision of the Main Control Loop or as operator commands. Similar processing is involved in both cases. For scenario events, no action is taken when the emitter or platform has the "operator's" status set, except for Delete Platform or Delete Emitter Event. All events which are executed are recorded in the Data Extraction File. Specific events are executed as follows.

4.11.1 Enter New Platform

An Enter New Platform Event initializes a new record in the Platform File. If the platform number is already in use, no action is taken unless the platform specified is the EW system platform. The motion parameters from the event are stored in the Platform File, and the Bearing and Range Attenuation fields are zeroed. When new data are entered for the EW system platform, the new Heading is output to the Digital Subsystem. Operator's status is set when an operator initiated event is processed.

4.11.2 Delete Platform

The specified platform and any associated emitters are deleted from the simulation. Records in the Platform File and Emitter File are marked as unused, and the emitters are turned off in the Digital Subsystem. Scenario events can delete "operator's" platforms.

4.11.3 Velocity Change

The velocity related parameters are updated in the Platform File. If the event references the EW system platform, the new Heading is output to the Digital Subsystem. Bearing and Range Attenuation are recalculated by the next Update sequence.

4.11.4 Platform Reposition

The position related parameters are updated in the Platform File. If the event references the EW system platform, the new Heading is output to the Digital Subsystem. Bearing and Range Attenuation are recalculated by the next Update sequence.

4.11.5 Enter New Emitter

The Parameter Change Bits are checked, and any Bits set inhibit loading of data for the parameter group from a scenario event. All other groups are loaded in the Digital Subsystem, and necessary data is stored in the Emitter File. The emitter is linked to the specified platform. Consecutive records are assigned in the Emitter File for emitters having multiple PRI values. When all data have been loaded to the Digital Subsystem, the emitter(s) is turned on, and the Record Dropout Data flag is set if recording is enabled.

No emitters may be linked to the EW system platform. No action is taken when this is attempted.

4.11.6 Delete Emitter

The specified emitter is turned off in the Digital Subsystem and the Emitter File record is marked as unused. The "operator's" flag and Record Dropout Data Flag are cleared, but any Parameter Change Bits which are set are preserved. If the emitter has multiple PRI values, all emitters assigned to the PRI chain are affected. The link to the associated platform is deleted.

4.11.7 Emitter Off

The specified emitter is turned off in the Digital Subsystem and appropriate flags in the Emitter File are updated. When a multiple PRI emitter is specified, all emitters in the PRI chain are affected.

4.11.8 Emitter On

The specified emitter is turned on in the Digital Subsystem and appropriate flags in the Emitter File are updated. When a multiple PRI emitter is specified, all emitters in the PRI chain are affected.

4.11.9 Change Emitter Parameter

The information in the event is used to update the Emitter File and/or output to the Digital Subsystem.

If the event is entered by the operator, the appropriate Parameter Change Bit is set in the Emitter File. This prevents any future scenario events from modifying the parameter group just updated.

4.12 FILE SUPPORT

Both Scenario and Data Extraction Files are stored in DEC RK05 diskpacks. Input and output to these files is done under control of the RSX-11M file management system in Files-11 format.

Scenario File input is multiply buffered to allow maximum throughput. The number of buffers to be used is specified at assembly time and is currently set to three. Buffer control is provided under control of an AST routine. When the Scenario File is opened, a request is issued to read the first block of data, and a wait is executed. When the first block has been read, the second block is requested and the AST is enabled. From this point on, the AST routine is entered each time a read is completed.

The AST routine first checks for any error returns. Any error other than an end of file is fatal, and a flag is set causing REALTM to terminate itself and abort program OTASK. An end of file causes a -1 to be placed in the first two words of the empty buffer. The AST routine then determines if the next buffer is empty and issues a read request if it is. Once the file is opened, the AST routine controls all reads and the Control Loop need not monitor buffer status.

An entry point is provided to release the next available event. The event type, time, and a pointer to the buffer location of the associated parameters are returned. If all buffers are currently empty, all zeroes are returned. The zero event type is used as a flag, and the zero time ensures that the mainline program will request another event the next time it cycles through its loop. When an end of file has been encountered, the -1 will be returned in the time field after all other events have been processed. The Control Loop makes an unsigned comparison of all time fields, so the -1 is interpreted as the highest possible number. Simulated Time never reaches the next event time and scenario event processing is suspended.

Data Extraction File output is also multiply buffered. The number of buffers is specified at assembly time, and is currently set to five. The Data Extraction File is initially allocated 300 contiguous disk blocks, and is extended as needed automatically. Buffers are maintained under control of an AST routine, similar to the Scenario File Control.

An entry point is provided to record an event or command. Inputs include the event or command number, the length, and a pointer to the memory location of the associated parameters. The time is automatically fetched from common area OPERC. Data are transferred to the output buffers, and disk writes are initiated as buffers are filled. If no buffer space is available, the program waits for the disk to catch up, suspending all other processing so that no data are lost.

The AST routine checks for any output errors. If an error is encountered, either a disk failure or a lack of disk space for an extend, a flag is set inhibiting further output. No further data can be recorded in the Data Extraction File, but all other normal processing continues. When the simulation run is ended, an attempt is made to close the Data Extraction File. If the error was caused by a lack of disk space, this will be successful and the data can be saved. If the error was caused by a true hardware failure, the attempt will fail and the file is left in an unusable state. If the file is marked as locked by an L next to the date in the directory listing from PIP, the data cannot be recovered and the file should be deleted.

APPENDIX A

SCENARIO FILE DESCRIPTION

The Scenario File is made up of a series of variable length records, each describing a single event. Events are stored in chronological order, with platform events in order of increasing platform number preceeding emitter events in order of increasing emitter number when events have equal time fields. The records are packed into 256 word blocks, with each event record contained completely in one block. Any unused words at the end of a block are filled with zeroes, so that no event crosses a block boundary. Blocks of data are written in Files-11 format, defined by Digital Equipment Corporation (DEC) as part of the RSX-11M operating system. The Scenario File is produced by an offline program and stored on a DEC RKD05 Diskpact to be read as needed by the real time software.

There are nine valid event types which may be used to describe platform motions and emitter characteristics. The first field of each event record contains the single word event type, which is an integer between one and nine. The second field of each event record contains the single word event time expressed in seconds at which the event is to be executed.

All two word fields are 32 bit signed twoes complement integers, with the first word containing the most significant half and the second word the least significant half. All one word fields are 16 bit signed twoes complement integers. The following event types are used to generate Scenario Files. All byte and bit defined fields are unsigned integers or codes.

1	Enter New Platform
2	Delete Platform
3	Velocity Change
4	Platform Reposition
5	Enter New Emitter
6	Delete Emitter
7	Emitter Off
8	Emitter On
9	Change Emitter Parameter

A.1 Enter New Platform

WORD/BIT	15	8 7	0
0		EVENT TYPE = 1	
1		TIME IN SECONDS	
2	0		PLATFORM NUMBER
3		HEADING (LSB = .3515625 DEGREE)	
4 5		X POSITION (LSB = .125 METER)	
6 7		Y POSITION (LSB = .125 METER)	
8 9		Z POSITION (LSB = .015625 METER)	
10		X VELOCITY (LSB = .125 METER/SEC)	
11		Y VELOCITY (LSB = .125 METER/SEC)	
12		Z VELOCITY (LSB = .015625 METER/SEC	

A.2 Delete Platform (and Associated Emitters)

WORD/BIT	15	8 7	0
0	EVENT TYPE = 2		
1	TIME IN SECONDS		
2	0	PLATFORM NUMBER	

A.3 Velocity Change

WORD/BIT	15	8 7	0
0	EVENT TYPE = 3		
1	TIME IN SECONDS		
2	0	PLATFORM NUMBER	
3	HEADING (LSB = .3515625 DEGREES)		
4	X VELOCITY (LSB = .125 METER/SEC)		
5	Y VELOCITY (LSB = .125 METER/SEC)		
6	Z VELOCITY (LSB = .015625 METER/SEC)		

A.4 Platform Reposition

WORD/BIT	15	8 7	0
0		EVENT TYPE = 4	
1		TIME IN SECONDS	
2	0		PLATFORM NUMBER
3		HEADING (LSB = .3515625 DEGREE)	
4		X POSITION (LSB = .125 METER)	
5			
6		Y POSITION (LSB = .125 METER)	
7			
8		Z POSITION (LSB = .015625 METER)	
9			

A.5 Enter New Emitter

WORD/BIT	15 — 12	11 — 8	7 — 0
0	EVENT TYPE = 5		
1	TIME IN SECONDS		
2	ANTENNA SCAN		PLATFORM NUMBER
3	EMITTER NUMBER		
4	LOWER SCAN BOUNDARY		
5	SCAN SECTOR WIDTH		
6	+	SCAN RATE INDEX	
7	FREQUENCY AGILE CODE		RF CHANNEL SELECTION
8	FREQUENCY		
9	RADIATED POWER		CHIRP RATE
10	PULSE WIDTH		
11	0		ASYNCHRONOUS OFFSET
12	*	PRI JITTER	NUMBER OF PRI'S
13	1st PRI		
14	2nd PRI		
	LAST PRI		

* WORD 12 - Bit 12 = PRIORITY FLAG

\+ WORD 6 - Bit 15 SCAN RETURN BLANK FLAG

A.6 Delete Emitter

WORD	15		0
0		EVENT TYPE = 6	
1		TIME IN SECONDS	
2		EMITTER NUMBER	

A.7 Emitter Off

WORD	15		0
0		EVENT TYPE = 7	
1		TIME IN SECONDS	
2		EMITTER NUMBER	

A.8 Emitter On

WORD	15		0
0		EVENT TYPE = 8	
1		TIME IN SECONDS	
2		EMITTER NUMBER	

A.9 Change Emitter Parameter

WORD	15	8 7	0
0	EVENT TYPE = 9		
1	TIME IN SECONDS		
2	EMITTER NUMBER		
3	A		PARAMETER NUMBER
4	B		
5	C		
6	D		

PARAMETER NUMBER	FIELD A	FIELD B	FIELD C	FIELD D
1	ANTENNA SCAN	LOWER SECTOR BOUNDARY	SCAN SECTOR WIDTH	SCAN RATE INDEX +
2	RADIATED POWER	THRESHOLD (RIGHT JUSTIFIED)	NOT INCLUDED	NOT INCLUDED
3	CHIRP RATE	FREQUENCY AGILE CODE/ RF CHANNEL SELECTION	FREQUENCY	NOT INCLUDED
4	ASYNC OFFSET	PULSE WIDTH	NOT INCLUDED	NOT INCLUDED
5	PRI JITTER CODE *	NUMBER OF PRI'S	1st PRI	2nd PRI ...

If more than one PRI is specified for parameter number five, PRI's are stored in consecutive words starting with field C.

* WORD 3 - BIT 12 - PRIORITY FLAG

\+ WORD 6 - BIT 15 - SCAN RETURN BLANK FLAG

APPENDIX B

DATA EXTRACTION FILE DESCRIPTION

The Data Extraction file is made up of a series of variable length records each describing a single scenario event, operator command or status event. Data is recorded in the order of command or event execution. The records are packed into 256 word blocks, which are written sequentially to a DEC RK05 diskpack in Files-11 format. Events or commands are allowed to cross block boundaries when necessary. Any extra words in the last block are filled with zeroes when the Data Extraction File is closed. Data analysis files are read and processed offline as required for performance evaluation.

The Data Extraction file contains all scenario events, operator commands, and status data pertinent to a simulation run. The first field of each record is the event or command code, as described below. The second field of each record is the actual event execution time. The time value stored in the data extraction file represents elapsed time since the start of the simulation run. The least significant bit of the 32 bit integer value represents one sixtieth of a second, often referred to as a tick.

CODE	EVENT OR COMMAND
1	Enter New Platform
2	Delete Platform
3	Velocity Change
4	Platform Reposition
5	Enter New Emitter
6	Delete Emitter
7	Emitter Off
8	Emitter On
9	Change Emitter Parameter
30	Dropped Emitter
31	RF Detector-Counter Reading
32	Dropout Counts
64	Start Scenario
65	Stop Scenario
66	Change Scenario Speed
67	Radiation Off
68	Radiation On
69	Advance Scenario
70	Backup Scenario
71	Set Counter Variables
72	Set RF Detector - Counter Band
73	Specify EW System Platform
74	End Simulation Run
75	Enable-Disable Dropout Recording
76	Record Special Channel Frequencies

B.1 Codes 1-9

Event codes one through nine correspond to the nine event types specified in the scenario file. These events, with the exception of the time field, are stored exactly as described in appendix A. The time field contains the two word time count as described above, rather than the one word simulated time value. Data for operator entered events are stored in the same format as data for scenario events. To distinguish operator events from scenario events, the event codes for operator events are negated as they are written to the data extraction files.

B.2 Code 30 - Dropped Emitter

WORD	
0	EVENT TYPE = 30
1	TICK COUNT
2	
3	EMITTER NUMBER

B.3 Code 31 - RF Detector-Counter Reading

WORD	
0	EVENT TYPE = 31
1	TICK COUNT
2	
3	RF BAND
4	DETECTOR COUNT

B.4 Code 32 - Dropout Counts

WORD	
0	EVENT TYPE = 31
1	TICK COUNT
2	
3	REQUEST TIME
4	
5	COUNT FOR 1ST ENABLED EMITTER
6	COUNT FOR 2ND ENABLED EMITTER
7	COUNT FOR 3RD ENABLED EMITTER
	COUNT FOR LAST ENABLED EMITTER
	-1

B.5 Code 64 - Start Scenario

WORD	
0	EVENT TYPE = 64
1	TICK COUNT
2	
3	STOP TIME

B.6 Code 65 - Stop Scenario

WORD	
0	EVENT TYPE = 65
1	TICK COUNT
2	

B.7 Code 66 - Set Scenario Speed

WORD	
0	EVENT TYPE = 66
1	TICK COUNT
2	
3	SPEED CODE

B.8 Code 67 - Radiation Off

WORD	
0	EVENT TYPE = 67
1	TICK COUNT
2	

B.9 Code 68 - Radiation On

WORD	
0	EVENT TYPE = 68
1	TICK COUNT
2	

B.10 Code 69 - Advance Scenario

WORD	
0	EVENT TYPE = 69
1	TICK COUNT
2	
3	ADVANCE TARGET TIME

B.11 Code 70 - Backup Scenario

WORD	
0	EVENT TYPE = 70
1	TICK COUNT
2	
3	BACKUP TARGET TIME

B.12 Code 71 - Set Counter Variables

WORD	
0	EVENT TYPE = 71
1	TICK COUNT
2	
3	MODE SELECT
4	PERIODICITY

B.13 Code 72 - Set RF Detector-Counter Band

WORD	
0	EVENT TYPE = 72
1	TICK COUNT
2	
3	BAND SELECT

B.14 Code 73 - Specify EW System Platform

WORD	
0	EVENT TYPE = 73
1	TICK COUNT
2	
3	EW SYSTEM PLATFORM NUMBER

B.15 Code 74 - End Simulation Run

WORD	
0	EVENT TYPE = 75
1	TICK COUNT
2	

B.16 Code 75 - Enable-Disable Dropout Recording

WORD	
0	EVENT TYPE = 75
1	TICK COUNT
2	
3	SELECT-DESELECT FLAG
4	START OF RANGE
5	END OF RANGE

B.17 Code 76 - Record Special Channel Frequencies

WORD	
0	EVENT TYPE = 76
1	TICK COUNT
2	
3	RF Channel Selection ~~First RF Source~~ VCO CHANNEL 1, POSITION 1
4	FREQUENCY CHANNEL 1, POSITION 1
5	VCO CHANNEL 1, POSITION 2
6	FREQUENCY CHANNEL 1, POSITION 2
7	VCO CHANNEL 1, POSITION 3
8	FREQUENCY CHANNEL 1, POSITION 3
9	VCO CHANNEL 1, POSITION 4
10	FREQUENCY CHANNEL 1, POSITION 4
11	VCO CHANNEL 1, POSITION 5
12	FREQUENCY CHANNEL 1, POSITION 5
13	VCO CHANNEL 2, POSITION 1
14	FREQUENCY CHANNEL 2, POSITION 1
15	VCO CHANNEL 2, POSITION 2
16	FREQUENCY CHANNEL 2, POSITION 2
17	VCO CHANNEL 2, POSITION 3
18	FREQUENCY CHANNEL 2, POSITION 3
19	VCO CHANNEL 2, POSITION 4
20	FREQUENCY CHANNEL 2, POSITION 4
21	VCO CHANNEL 2, POSITION 5
22	FREQUENCY CHANNEL 2, POSITION 5

APPENDIX C

MAXIMUM POWER, ANTENNA PATTERN, THRESHOLD FILES

The Maximum Power, Antenna Pattern and Threshold file all have identical formats. Each consists of a total of one hundred and sixty records. Each record contains a single floating point value stored in ASCII format. The files are created using the text editing utility supplied as part of RSX-11M. An optional comment may be placed on each line, by placing a comma in the first column after the value field, followed by any ASCII text string. The value field is of no fixed length, and is terminated by either the comma if a comment is included, or by the carriage return if no comment is present. Leading and trailing spaces are read as zeroes, so no unnecessary spaces should be left before the return or comma.

The 160 entries represent 16 entries for each of 10 RF radiation bands. The 16 entries should be spaced evenly throughout the range of the specific band. Data are stored first for band zero, then band one, band two, etc., up to band nine. Frequencies associated with each record, therefore, are always increasing as the file is read. As an example, the first 16 records of a fictitious file are included, showing data for band zero. Frequency values are shown to illustrate points where actual parameters should be evaluated.

```
515.625, first frequency, band 0
546.875, second frequency, band 0
578.125, third frequency, band 0
609.375, fourth frequency, band 0
640.625, fifth frequency, band 0
671.875, sixth frequency, band 0
703.125, seventh frequency, band 0
734.375, eighth frequency, band 0
765.625, nineth frequency, band 0
796.875, tenth frequency, band 0
828.125, eleventh frequency, band 0
859.375, twelvth frequency, band 0
890.625, thirteenth frequency, band 0
921.875, fourteenth frequency, band 0
953.125, fifteenth frequency, band 0
984.375, sixteenth frequency, band 0
```

The Maximum Power file contains the maximum power output of the simulator available for each frequency in dBm. The Antenna Pattern file contains the receiving antenna gain for each frequency in dB, and the Threshold file contains default power levels in dBm below which the simulator will not attempt to generate a signal.

APPENDIX D

DIGITAL SUBSYSTEM INTERFACE

The interface between the Digital Subsystem and the Control Subsystem consists of three 16 bit data paths plus associated status lines and a Dropped Emitter Flag. The three paths are Command Data, Status Data and Dropout Data.

D.1 COMMAND DATA

The Command Data path consists of 16 data lines from the Control Subsystem to the Digital Subsystem plus a control line. The interface is terminated in the Control Subsystem by a DR-11M interface card supplied by DEC. The sixteen data lines of port B are used, and a Unibus address of 764020 is selected. The DATA READY OUT B signal is asserted whenever new data is loaded into the B port output register. All signals are TTL compatible levels.

Commands are output at a maximum rate of one every 8 microseconds. No acknowledgment is required from the Digital Subsystem.

The data path is divided into two fields: a Command Field in the most significant six bits and a Value field in the ten least significant bits. When all of the Value bits are not used, the field is right justified and the unused bits are undefined.

When an emitter number is loaded, all subsequent commands reference this emitter until a new emitter number is loaded. All angles (bearings and headings) are ten bit fields in units of 360/1024 Degrees, referred to as Binary Angular Measure (BAMs). A list of valid commands and Value fields follows.

COMMAND CODE	COMMAND	VALUE FIELD
0	Load Emitter Number	10 bit Emitter Number
1	Antenna Scan	8 bit Scan Type
2	Lower Limit	10 bit Lower Scan Sector Boundary
3	Sector Width	10 bit Scan Sector Width
4	Scan Rate Index	10 bit Scan Rate Index (Note 1)
5	Emitter Bearing	10 bit True Bearing of Emitter from the EW System Platform
6	Load Composite Emitter Heading & Bearing	10 bit Relative Bearing of EW System Platform from the Emitter, Shifted by Scan Multiplier Code
7	Load Attenuation	8 bit Attenuation in Db, twoes complement Integer
8	Load Pulse Width	10 bit Pulse Width in Units of .1 usec.
9	Load Frequency 1	4 bit Frequency Agile Code (Note 2) (Most Significant), 6 bit VCO selection
10	Load Frequency 2	10 Least Significant bits of Frequency (Note 3)
11	Load Chirp Rate	2 Most Significant bits of Frequency (Most Significant bits), 8 bit Chirp Rate (Note 4)
12	Load PRI 1	1 bit Priority Flag (Most Significant), 4 bit Jitter Code, (Note 5), 2 Most Significant bits of PRI
13	Load PRI 2	10 Least Significant Bits of PRI in usec.
14	Load Stagger/Group Code	10 bit Stagger/Group Code (Note 6)
15	Load Active Flag	1 bit Active Flag, 1=on, 0=off
16	Load Threshold	8 bit Output Threshold in Db
17	Load Asynchronous Offset	5 bit Asynchronous Offset in Units of 50 nsec. maximum 17: (Code 1 = 0 Offset)
18	Load Scan Return Blank	1 Bit Blank Flag, 1 = Blank, 0 = No Blank
19	Load Linked Active Flag	1 bit Active Flag, 1=on 0=off

25	Load Dropout Count Selection	2 bit to select input to Dropout Counters 0 = Pulse is output 1 = Pulse is inhibited by amplitude threshold 2 = Pulse is dropped due to lack of RF Subsystem capacity 3 = Pulse is jittered by Digital Subsystem
26	Load Hours	4 bits BCD Hours
27	Load Minutes	2 4 bit BCD Characters for Minutes
28	Load Seconds	2 4 bit BCD Characters for Seconds
29	Load Own Heading	10 bit EW System Platform Heading
30	Change Active Flags	1 Bit Active Flag, 1 = On, 0 = off (Affects All Emitters From Current to 1023)
31	Load RF Enable Flag	1 bit Flag. 1 = Enable RF Radiation 0 = Disable RF Radiation
32	Read Emitter Number	
33	Read Antenna Scan	
34	Read Lower Limit	
35	Read Sector Width	
36	Read Scan Rate Index	
37	Read Emitter Bearing	
38	Read Emitter Heading	
39	Read Attenuation	
40	Read Pulse Width	
41	Read Frequency 1	
42	Read Frequency 2	
43	Read Chirp Limits	
44	Read PRI 1	
45	Read PRI 2	
46	Read Stagger/Group Code	
47	Read Active Flag	
48	Read Threshold	

49	Read Asynchronous Offset	
50	Read Scan Return Blank	
53	Read Dropped Emitter Number	
54	Read and clear RF Detector Counter and Set Band Select	Band Number (0-5) 3 bit right justified
55	Initiate Transfer of Dropout Counts	0 For All, or Specific Emitter Number
57	Read Dropout Count Selection	
61	Read Own Heading	
62	Read Band Select Register	
63	Read RF Enable Flag	

<u>Note 1 - Scan Rate Index</u>

The following algorithm is used to derive the field value:

PPI = PRF * SRI * (Multiplier) (360/1024) / (Sector Width)/(Direction Code + 1)

where: PRF is pulse repetition frequency

SRI is scan rate interval

Multiplier is a function of beamwidth

Direction Code is 0 for unidirectional, 1 for bidirectional

The PRF should take into account all pulses of a group or staggered levels. SRI is the time required for one complete cycle of scan activity.

For PPI   0.67, round the value to the nearest integer. Limit the value to 511 for maximum field length. Bit 9 should be zero.

For PPI   0.67, invert the value (1/PPI) and round to the nearest integer. The field length should be observed (max. 511) and the flag, Bit 9, should be set to one.

<u>Note 2 - Frequency Agile Code</u>

The Frequency Deviation in MHz is translated to Frequency units and the code derived from the following table.

Code	No. of LSB Frequency Units
0	0
1	1
2	2
3	4
4	8
5	16
6	32
7	64
8	128
9	256
10	512
11	1024
12	2048
13	4096
14 - 15	Unused

Note 3 - Frequency

The field contains the radio frequency (RF) of the emitter, within the band designated by the RF Channel Selection Code and èxpressed in the following LSB units.

RF (GHz)	LSB Units (MHz)
.5 - 1	.122 MHz
1 - 2	.244 MHz
2 - 18	.488 MHz

Note 4 - Chirp Rate

The rate can be determined from the amount of frequency deviation (chirp limit) divided by the pulse width. The units of chirp rate vary with frequency band and are defined as follows:

	CHIRP RATE	
RF (GHz)	LSB Weight (MHz/usec)	Max. Value (MHz/usec) (for 8 bit Field)
5-1	0.39	100
1-2	0.78	200
2-4	1.56	400
4-8	3.13	800
8-12	3.13	800
12-18	4.69	1200

Note 5 - Jitter Code

The PRI Jitter limit in micro-seconds should be used to derive the PRI Jitter Code by locating the closest value in the following table.

PRI JITTER CODE

Code	Jitter (useconds)
0	0
1	1
2	2
3	4
4	8
5	16
6	32
7	64
8	128
9	256
10	512
11	1024
12	2048
13	4096
14 - 15	Unused

Note 6 - Stagger/Group Code

The Stagger/Group Code is the displacement to the emitter number of the next PRI in the pulse train in twoes complement form.

D.2 STATUS DATA

The Status Data path consists of sixteen data lines from the Digital Subsystem to the Control Subsystem. The sixteen lines are driven by a sixteen bit status register which always contains the data selected by the last Read command received from the Control Subsystem. The information is right justified with unused bits set to zero. Data selected by commands 32-48 are identical in format to data in the value fields of the corresponding Load commands (0-16). Other data formats are described in Sections D.2.1 and D.2.2.

The interface is terminated in the Control Subsystem by a DR-11L interface card supplied by DEC. The sixteen data lines of port A are used, and a Unibus address of 764030 is selected. The DATA READY IN A signal is asserted to latch new data

into the DR-11L within 8 microseconds of receipt of a Read command. All levels are TTL compatible.

D.2.1 Dropped Emitter Number

When the Digital Subsystem discovers that it has gone .5 seconds without generating a pulse for an active emitter, it saves the emitter number and asserts the status in a signal in the DR-11 in the Control Subsystem interface. When the Control Subsystem processes the flag, it will issue a Read Dropped Emitter Number Command to which the Digital Subsystem will respond by moving the ten bit emitter number to the Status Register.

D.2.2 RF Detector Counter

The RF Subsystem has a Detector/Counter unit which counts the number of pulses in the VCO band specified in the last Read and Clear RF Detector Counter and Set Band Select Register Command (Command 54) which are above a threshold. The command also causes the 12 most significant bits of this counter to be transferred to the Status Register.

D.3 DROPOUT COUNTER

The Digital Subsystem maintains a 12 bit counter for each emitter number. The counter is incremented according to the last Load Dropout Count Selection Command (Command 25). Upon receipt of an Initiate Transfer of Dropout Counts command (Command 55), the Digital Subsystem shall transfer all of the dropout counters to the Control Subsystem via the Dropout Counts data path which is a Direct Memory Access channel into the main memory of the Control Subsystem. Each counter is cleared after it is transferred. The Digital Subsystem will prevent any of the counters from counting past the maximum number of 4095.

The Direct Memory Access channel is implemented by a DR-11B interface system supplied by DEC, using a Unibus address of 764000. The DATA AVAILABLE IN signal is asserted each time a data word is to be transferred. All levels are TTL compatible.

APPENDIX E

NAVIGATION COMPUTER INTERFACE

Periodically the position of the EW system platform is output to the Navigation Computer. The data transfer is accomplished using a standard RS-232 asynchronous interface. The message consists of twelve data words and two control words formatted as follows.

Control Code 7 6	Binary Data 5 4 3 2 1 0	Description	
1 0	0 0 0 0 0 0	Initiating code plus word count most significant bits.	
0 1	0 0 1 1 0 0	Word count continuation per least significant bits (Count of 12 is shown).	
0 0	S X X X X X	First data word: Sign (S) as most significant bit plus E-W data with upper significant bits 16-12.	
0 0	X X X X X X	Second data word: Continuation of E-W data with significant bits 11-6.	
0 0	X X X X X X	Third data word: last of E-W data by least significant bits 5-0.	
0 0	S Y Y Y Y Y	Fourth data word	Same as 1 thru 3 data words except for N-S in lieu of E-W.
0 0	Y Y Y Y Y Y	Fifth data word	
0 0	Y Y Y Y Y Y	Sixth data word	
0 0	S Z Z Z Z Z	Seventh data word	Same as 1 thru 3 and 4 thru 6 data words except for altitude in lieu of EW or N-S.
0 0	Z Z Z Z Z Z	Eighth data word	
0 0	Z Z Z Z Z Z	Ninth data word	
0 0	T T T T T T	Tenth data word: Time data with upper significant bits 17-12.	
0 0	T T T T T T	Eleventh data word: Continuation of time with bits 11-6.	
0 0	T T T T T T	Twelfth data word: Last of time data with least significant bits 5 thru 0.	

S = Sign bit (+ or -) with negative values in two's complement format

X,Y,Z = Binary grid position data

T = Binary present scenario time data

APPENDIX F

PLATFORM FILE

The Platform File contains a 14 word record for each of up to 256 platforms or sites. Records are indexed by platform number, and formatted as follows. Two word fields are 32 bit twoes complement integers.

WORD	
0	EMITTER POINTER
1	X VELOCITY
2	X POSITION
3	
4	Y VELOCITY
5	Y POSITION
6	
7	Z VELOCITY
8	Z POSITION
9	
10	PLATFORM HEADING
11	BEARING TO EW SYSTEM
12	RANGE ATTENUATION
13	PLATFORM FLAGS

DAT

FILM